1010 Auxiliary Lanes

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1010.01 General

Auxiliary lanes are used to comply with capacity requirements; to maintain lane balance; to accommodate speedx change, weaving, and maneuvering for entering and exiting traffic; or to encourage carpools, vanpools, and the use of transit.

See the Traffic Manual and the MUTCD for signing of auxiliary lanes.

Although slow vehicle turnouts, shoulder driving for slow vehicles, and chain-up areas are not auxiliary lanes they are covered in this chapter because they perform a similar function.

See the following chapters for additional information:

Chapter	Subject
910	Turn lanes
910	Speed change lanes at intersections
940	Speed change lanes at interchanges
940	Collector distributor roads
940	Weaving lanes
1050	High occupancy vehicle lanes

1010.02 References

Revised Code of Washington (RCW) 46.61, Rules of the Road.

Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), USDOT, FHWA; including the *Washington State Modifications to the MUTCD*, M 24-01. WSDOT *Traffic Manual*, M 51-02, WSDOT.

A Policy on Geometric Design of Highways and Streets (Green Book), AASHTO, 1994

Emergency Escape Ramps for Runaway Heavy Vehicles, FHWA-T5-79-201, March 1978

Highway Capacity Manual (Special Report 209), Transportation Research Board

NCHRP Synthesis 178, *Truck Escape Ramps*, Transportation Research Board

1010.03 Definitions

auxiliary lane The portion of the roadway adjoining the through lanes for parking, speed change, turning, storage for turning, weaving, truck climbing, passing, and other purposes supplementary to through-traffic movement.

climbing lane An auxiliary lane used for the diversion of slow traffic from the through lane.

emergency escape ramp A roadway leaving the main roadway designed for the purpose of slowing and stopping out-of-control vehicles away from the main traffic stream.

lane A strip of roadway used for a single line of vehicles.

lateral clearance The distance from the edge of traveled way to a roadside object.

posted speed The maximum legal speed as posted on a section of highway using regulatory signs.

passing lane An auxiliary lane on a two-lane highway used to provide the desired frequency of safe passing zones.

roadway The portion of a highway, including shoulders, for vehicular use. A divided highway has two or more roadways.

shoulder The portion of the roadway contiguous with the traveled way, primarily for accommodation of stopped vehicles, emergency use, lateral support of the traveled way, and use by pedestrians and bicycles.

slow moving vehicle turnouts A widened shoulder area to provide room for a slow moving vehicle to pull safely out of the through traffic, allow vehicles following to pass, and return to the through lane.

traveled way The portion of the roadway intended for the movement of vehicles, exclusive of shoulders and lanes for parking, turning, and storage for turning.

Warrant A minimum condition for which an action is authorized. Meeting a warrant does not attest to the existence of an unsafe or undesirable condition. Further justification is required.

1010.04 Climbing Lanes

(1) General

Normally, climbing lanes are associated with truck traffic, but they may also be considered in recreational or other areas that are subject to slow moving traffic. Climbing lanes are designed independently for each direction of travel.

Generally, climbing lanes are provided when the requirements of two warrants - speed reduction and level of service - are exceeded. The requirements of either warrant may be waived if, for example, slow moving traffic is demonstrably causing a high accident rate or congestion that could be corrected by the addition of a climbing lane. However, under most conditions climbing lanes are built when the requirements of both warrants are satisfied.

(2) Warrant No. 1 — Speed Reduction

Figure 1010-2a shows how the percent and length of grade affect vehicle speeds. The data is based on a typical heavy truck.

The maximum allowable entrance speed, as reflected on the graphs, is 55 mph. Note that this is the maximum value to be used regardless of the posted speed of the highway. When the posted speed is above 55 mph, use 55 mph in place of the posted speed. Examine the profile at least 1/4 mi preceding the grade to obtain a reasonable approach speed.

If a vertical curve makes up part of the length of grade, approximate the equivalent uniform grade length.

Whenever the gradient causes a 15 mph speed reduction below the posted speed limit for typical heavy truck for either two-lane or multilane highways, the speed reduction warrant is satisfied (see Figure 1010-2b for an example).

(3) Warrant No. 2 — Level of Service (LOS)

The level of service warrant for two-lane highways is fulfilled when the up-grade traffic volume exceeds 200 VPH and the up-grade truck volume exceeds 20 VPH. On multilane highways, use Figure 1010-3.

(4) Design

When a climbing lane is justified, design it in accordance with Figure 1010-4. Provide signing and delineation to identify the presence of the auxiliary lane. Begin climbing lanes at the point where the speed reduction warrant is met and end them where the warrant ends for multilane and 300 ft beyond for 2-lane highways. Consider extending the auxiliary lane over the crest to improve vehicle acceleration and the sight distance.

Design climbing lane width equal to that of the adjoining through lane and at the same cross slope as the adjoining lanes. When ever possible, maintain the shoulders at standard width for the class of highway. However, on two-way two-lane highways, the shoulder may be reduced to 4 ft with justification.

1010.05 Passing Lanes

(1) General

Passing lanes are desirable where a sufficient number and length of safe passing zones do not exist and the speed reduction warrant for a climbing lane is not satisfied. Figure 1010-5 may be used to determine if a passing lane is recommended.

(2) Design

When a passing lane is justified, design it in accordance with Figure 1010-6. Make the lane long enough to permit several vehicles to pass. Passing lanes longer than 2 mi can cause the driver to lose the sense that the highway is basically a two-lane facility.

Passing lanes are preferably four-lane sections.

A three-lane section may be used, however. Alternate the direction of the passing lane at short intervals to ensure passing opportunities for both directions and to discourage illegal actions of frustrated drivers.

Make the passing lane width equal to the adjoining through lane and at the same cross slope. Full-width shoulders for the highway class are preferred; however, with justification, the shoulders may be reduced to 4 ft. Provide adequate signing and delineation to identify the presence of an auxiliary lane.

1010.06 Slow Moving Vehicle Turnouts

(1) General

On a two-lane highway where passing is unsafe, a slow moving vehicle is required, by RCW 46.61.427, to turn off the through lane wherever a safe turnout exists, in order to permit the following vehicles to proceed. A slow moving vehicle is one that is traveling at a speed less than the normal flow of traffic, behind which five or more vehicles are formed in a line.

A slow moving vehicle turnout is not an auxiliary lane. Its purpose is to provide sufficient room for a slow moving vehicle to safely pull out of through traffic and stop if necessary, allow vehicles following to pass, then return to the through lane. Generally, a slow moving vehicle turnout is provided on existing roadways where passing opportunities are limited, where slow moving vehicles such as trucks and recreational vehicles are predominant, and where the cost to provide a full auxiliary lane would be prohibitive.

(2) Design

Base the design of a slow moving vehicle turnout primarily on sound engineering judgment and Figure 1010-7. Design may vary from one location to another. A minimum length of 100 ft provides adequate storage, since additional storage is provided within the tapers and shoulders. The maximum length is 1/4 mi including tapers. Surface turnouts with a stable unyielding material such as BST or ACP with adequate structural strength to support the heavier traffic.

Locate slow vehicle turnouts where at least Design Stopping Sight Distance (Chapter 650) is available, decision sight distance is preferred, so that vehicles can safely reenter the through traffic. Sign slow moving vehicle turnouts to identify their presence.

When a slow moving vehicle turnout is to be built, document the location and why it was selected.

1010.07 Shoulder Driving for Slow Vehicles

(1) General

For projects where climbing or passing lanes are justified, but are not within the scope of the project, or where meeting the warrants for these lanes are borderline, the use of a shoulder driving section is an alternative.

Review the following when considering a shoulder driving section:

- Horizontal and vertical alignment
- Character of traffic
- Presence of bicycles
- Clear zone (Chapter 700)

(2) Design

When designing a shoulder for shoulder driving, use a minimum length of 600 ft. The minimum shoulder width is 8 ft with 10 ft preferred. When barrier is present, the minimum width is 10 ft with 12 ft preferred. Adequate structural strength for the anticipated traffic is necessary and may require reconstruction. Select locations where the side slope meets the requirements of Chapter 640 for new construction and Chapter 430 for existing roadways. When a transition is required at the end of a shoulder driving section, use a 50:1 taper.

Signing for shoulder driving is required. Install guideposts when shoulder driving is to be permitted at night.

Document the need for shoulder driving and why a lane is not being built.

1010.08 Emergency Escape Ramps

(1) General

Consider an emergency escape ramp whenever long steep down grades are encountered. In this situation the possibility exists of a truck losing its brakes and going out of control at a high speed. Consult local maintenance personnel and check traffic accident records to determine if an escape ramp is justified.

(2) Design

(a) **Type.** Escape ramps are one of the following types:

- Gravity escape ramps are ascending grade ramps paralleling the traveled way. They are commonly built on old roadways. Their long length and steep grade can present the driver with control problems, not only in stopping, but with rollback after stopping. Gravity escape ramps are the least desirable design.
- Sand pile escape ramps are piles of loose, dry sand dumped at the ramp site, usually not more than 400 ft in length. The deceleration is usually high and the sand can be affected by weather conditions; therefore, they are less desirable than arrester beds. However, where space is limited they may be suitable.
- Arrester beds are parallel ramps filled with a smooth, coarse, free-draining gravel. They stop the out-of-control vehicle by increasing the rolling resistance. Arrester beds are commonly built on an up grade to add the benefits of gravity to the rolling resistance. However, successful arrester beds have been built on a level or descending grade.

(b) **Location.** The location of an escape ramp will vary depending on terrain, length of grade, and roadway geometrics. The best locations include in advance of a critical curve, near the bottom of grade, or before a stop. It is desirable that the ramp leave the roadway on a tangent at least 3 mi from the beginning of the down-grade.

(c) **Length.** Lengths will vary depending on speed, grade, and type of design used. The minimum length is 200 ft. Calculate the stopping length using the following equation:

$$L = \frac{V^2}{0.3(R \pm G)}$$

Where:

L = stopping distance (ft)
V = entering speed (mph)
R = rolling resistance (see Figure 1010-1)
G = grade of the escape ramp (%)

Speeds of out-of control trucks rarely exceed 90 mph; therefore, an entering speed of 90 mph is preferred. Other entry speeds may be used when justification and the method used to determine the speed is documented.

Material	R
Roadway	1
Loose crushed aggregate	5
Loose noncrushed gravel	10
Sand	15
Pea gravel	25

Rolling Resistance (R)
Figure 1010-1

(d) **Width.** The width of each escape ramp will vary depending on the needs of the individual situation. It is desirable for the ramp to be wide enough to accommodate more than one vehicle. The desirable width of an escape ramp to accommodate two out-of-control vehicles is 40 ft and the minimum width is 26 ft.

(e) The following items are additional considerations in the design of emergency escape ramps:

- If possible, at or near the summit, provide a pull-off brake-check area. Also, include informative signing about the upcoming escape ramp in this area.
- A free draining, smooth, noncrushed gravel is preferred for an arrester bed. To assist in smooth deceleration of the vehicle, taper the depth of the bed from 3 in at the entry to a full depth of 18 to 30 in in not less than 100 ft.
- Mark and sign in advance of the ramp. Discourage normal traffic from using or parking in the ramp. Sign escape ramps in accordance with the guidance contained in the MUTCD for runaway truck ramps.

- Provide drainage adequate to prevent the bed from freezing or compacting.
- Consider including an impact attenuator at the end of the ramp if space is limited.
- A surfaced service road adjacent to the arrester bed is needed for wreckers and maintenance vehicles to remove vehicles and make repairs to the arrester bed. Anchors are desirable at 300 ft intervals to secure the wrecker when removing vehicles from the bed.

A typical example of an arrester bed is shown in Figure 1010-8.

Include justification, all calculations, and any other design considerations in the documentation of an emergency escape ramp documentation.

1010.09 Chain-Up Area

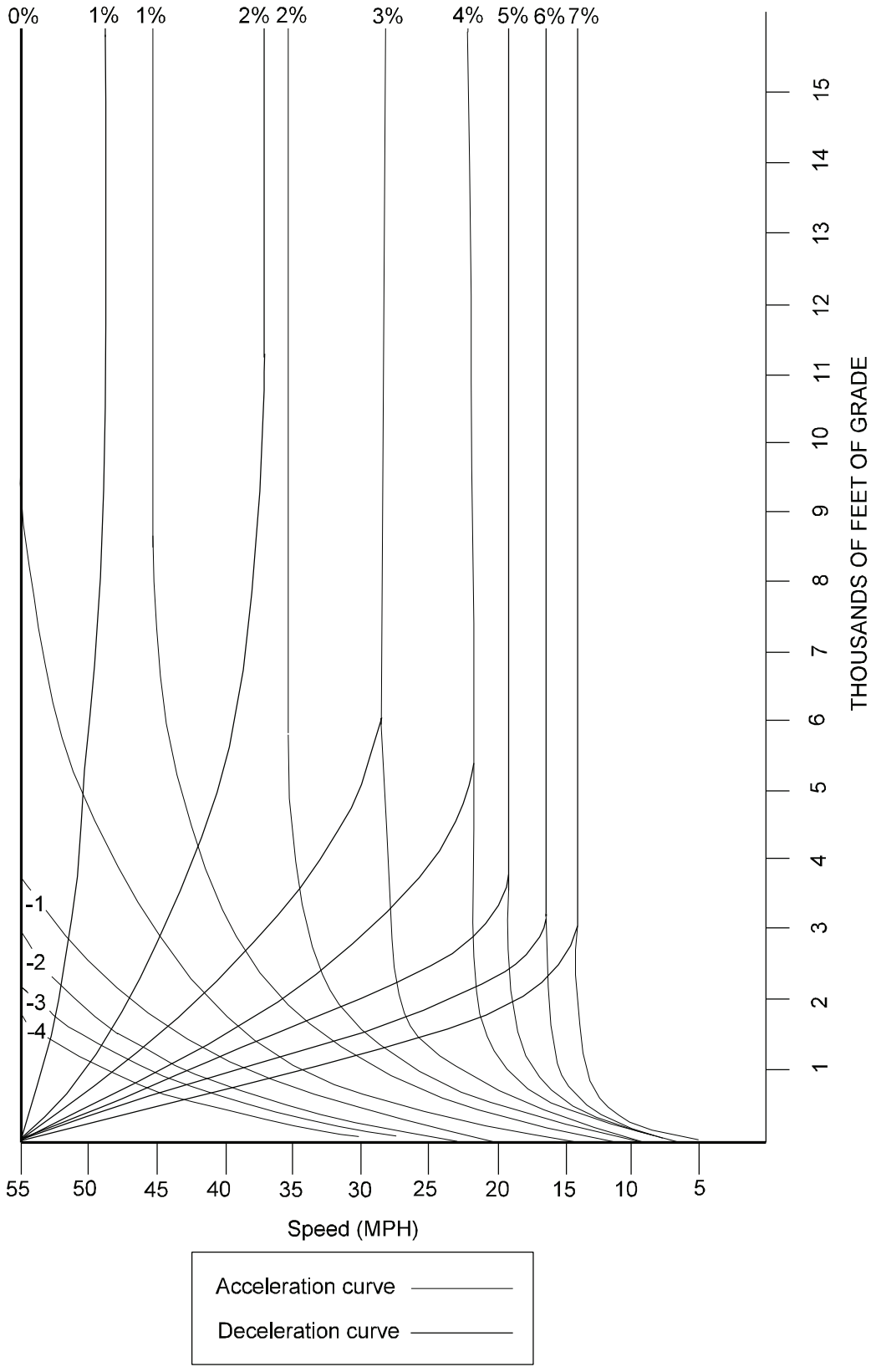
Provide chain-up areas to allow chains to be put on vehicles out of the through lanes at locations where traffic enters chain enforcement areas. Provide chain-off areas to remove chains out of the through lanes for traffic leaving chain enforcement areas.

Chain-up or chain-off areas are widened shoulders, designed as shown in Figure 1010-9. Locate chain-up and chain-off areas where the grade is 6% or less and preferably on a tangent section.

Consider illumination for chain-up and chain-off areas on multilane highways. When deciding whether or not to install illumination, consider traffic volumes during the hours of darkness and the availability of power.

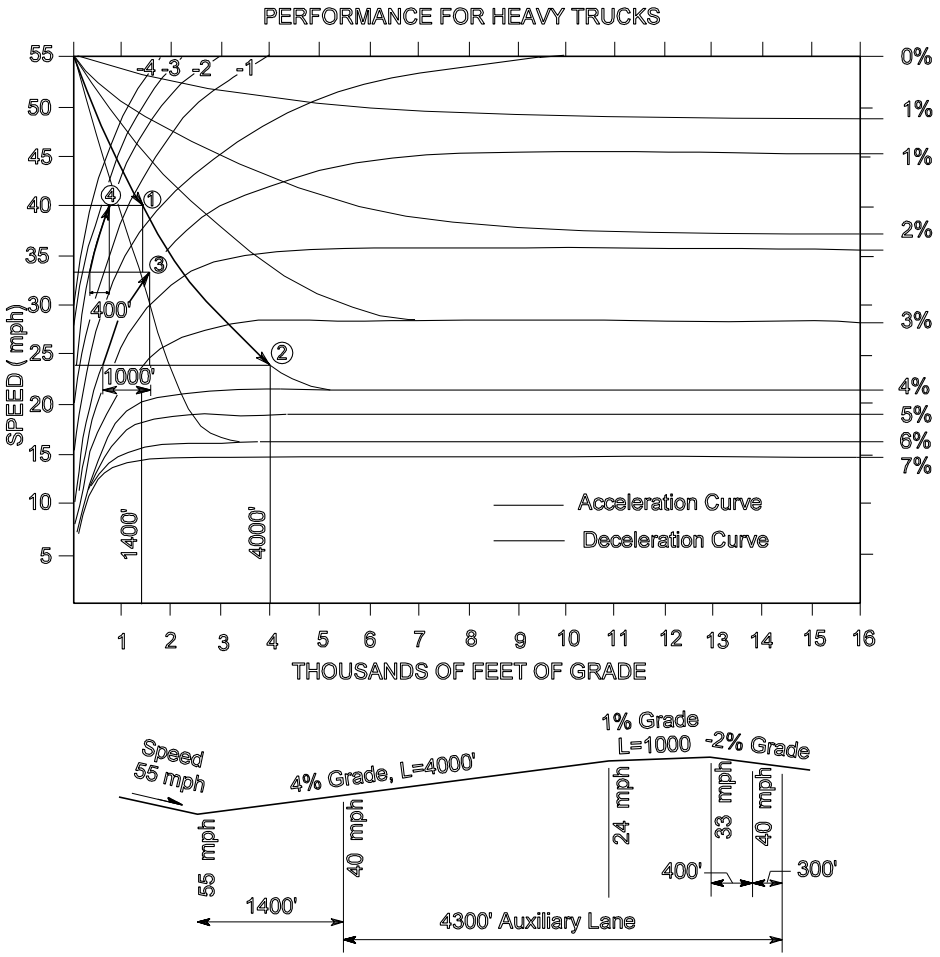
1010.10 Documentation

A list of the documents that are to be preserved [in the Design Documentation Package (DDP) or the Project File (PF)] is on the following web site: http//www.wsdot.wa.gov/eesc/design/projectdev/



Performance For Heavy Trucks

Figure 1010-2a



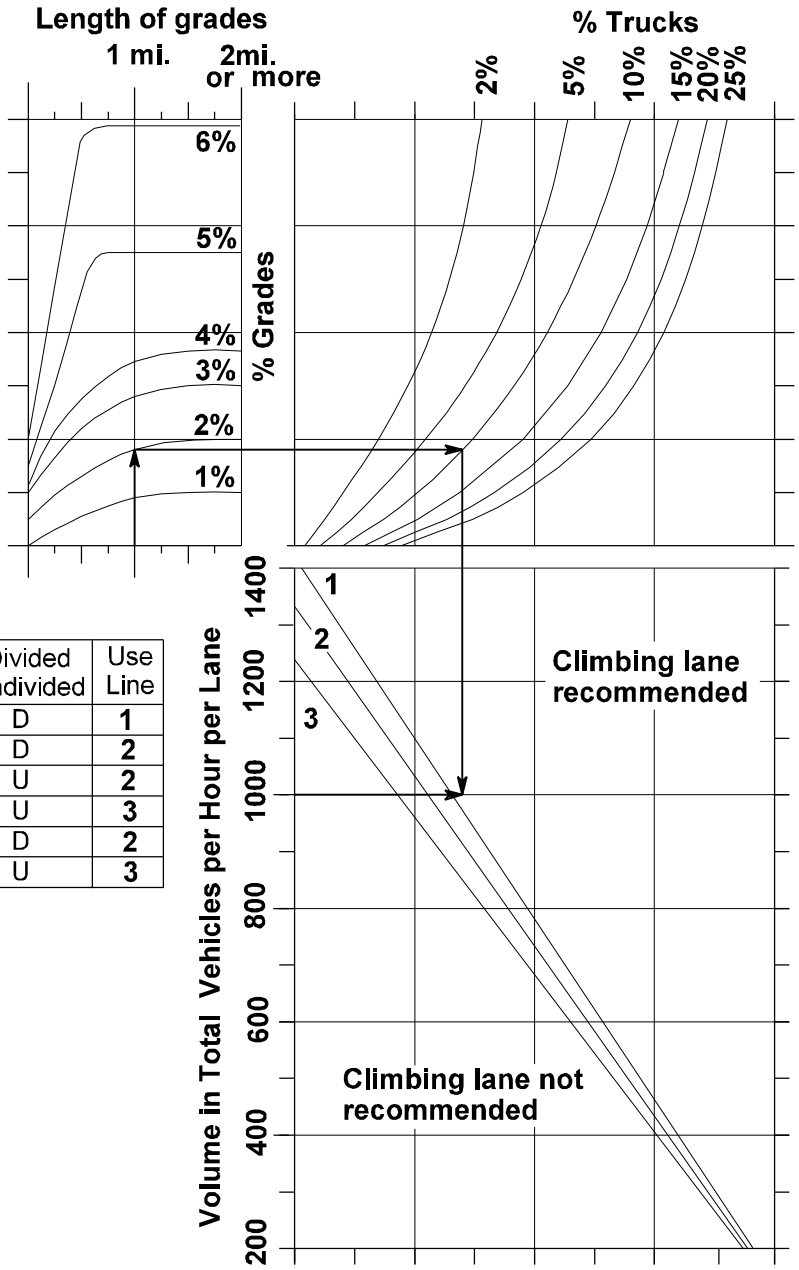
Given: A 2-lane highway meeting the level of service warrant, with the above profile, and a 55 mph posted speed.

Determine: Is the climbing lane warranted and, if so, how long?

Solution:

1. Follow the 4% grade deceleration curve from a speed of 55 mph to a speed of 40 mph at 1,400 ft. The speed reduction warrant is met and a climbing lane is needed.
2. Continue on the 4% grade deceleration curve to 4,000 ft. Note that the speed at the end of the 4% grade is 25 mph.
3. Follow the 1% grade acceleration curve from a speed of 25 mph for 1,000 ft. Note that the speed at the end of the 1% grade is 34 mph.
4. Follow the -2% grade acceleration curve from a speed of 34 mph to a speed of 40 mph, ending the speed reduction warrant. Note the distance required is 400 ft.
5. The total auxiliary lane length is (4,000-1,400)+1,00+400+300=4,300 ft. 300 ft is added to the speed reduction warrant for a 2-lane highway, see the text and Figure 1010-4.

Speed Reduction Example
Figure 1010-2b

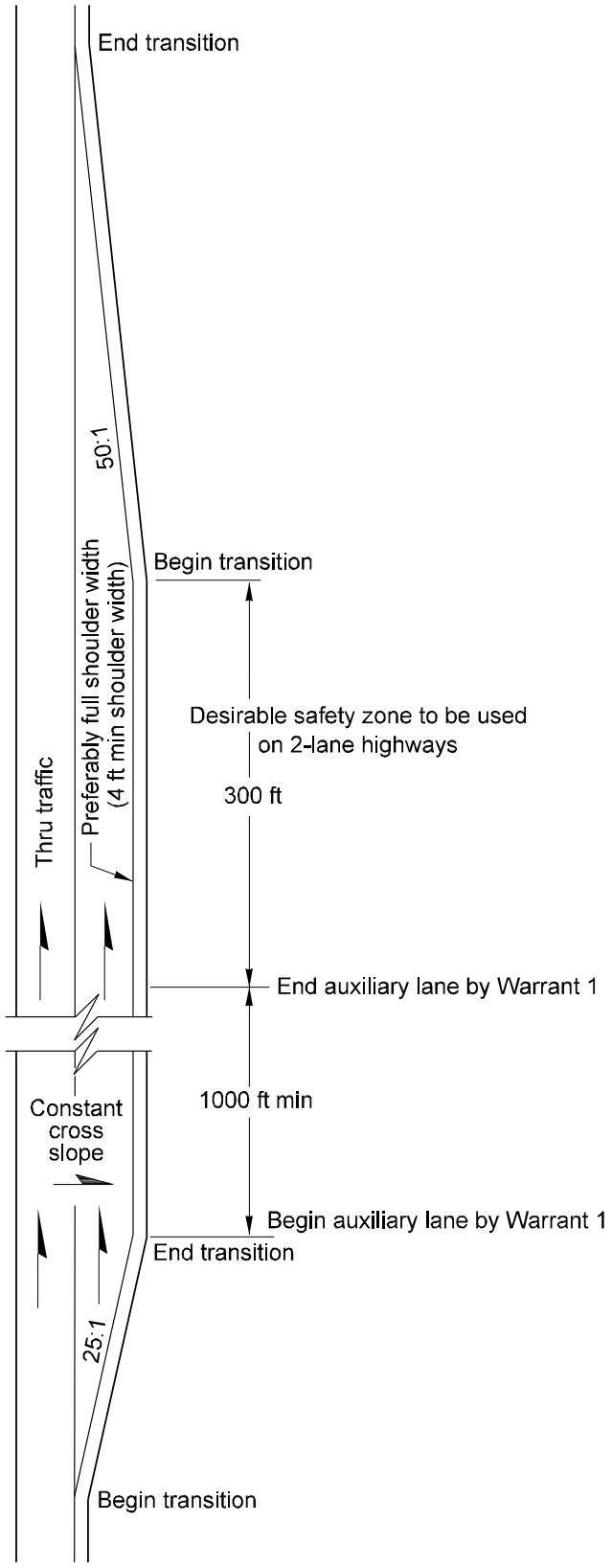


Lane Width	Lateral Clearance	Divided Undivided	Use Line
12	≥ 6	D	**1**
12	≤ 6	D	**2**
12	≤ 6	U	**2**
12	< 6	U	**3**
11	All	D	**2**
11	All	U	**3**

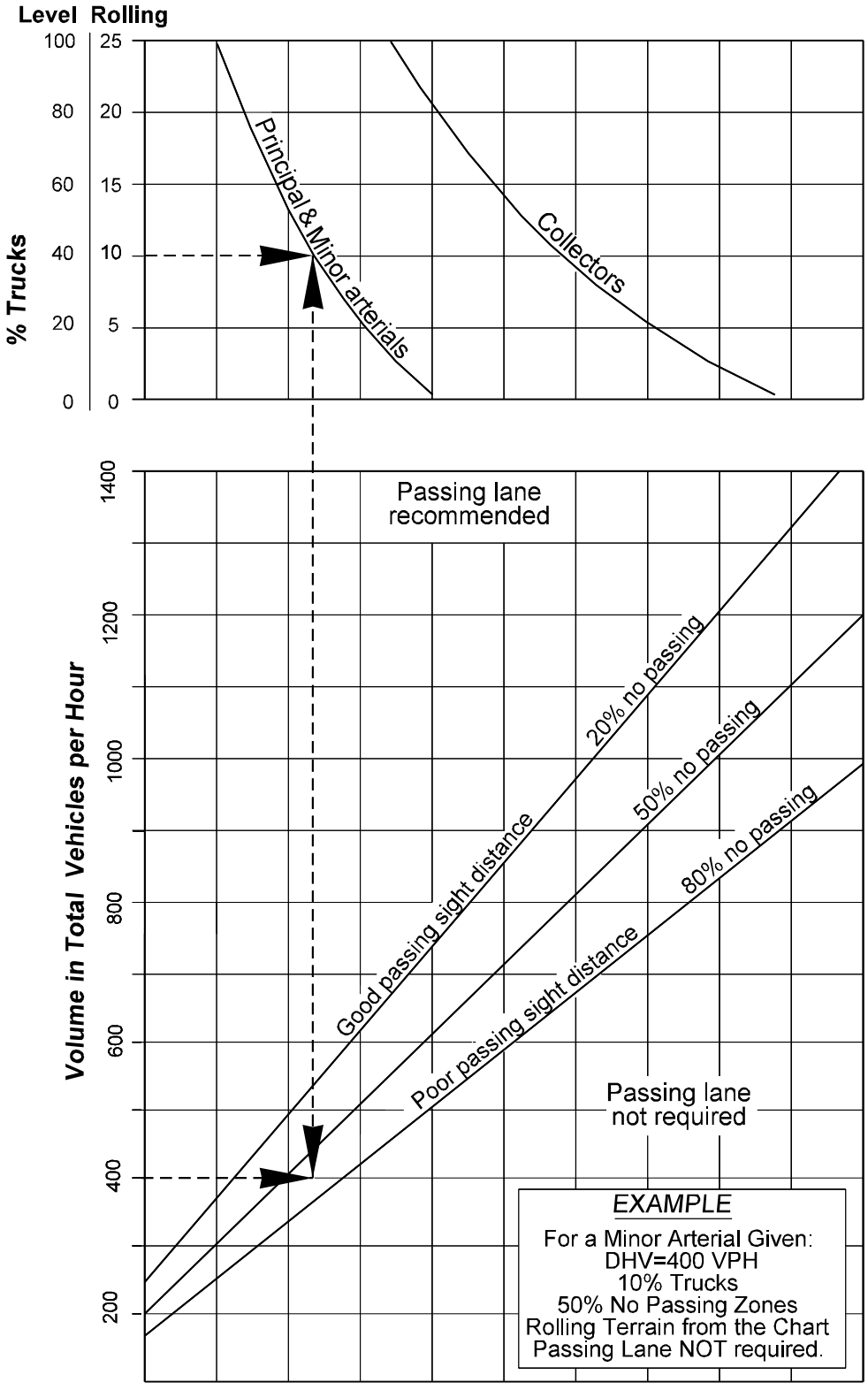
Example

2% grade for 1 Mile
10% Trucks
12' Lanes
Lateral Clearance
≥ 6'
4 Lane, Divided
DDHV = 2000
From the chart,
climbing lane
is recommended

Level of Service — Multilane
Figure 1010-3

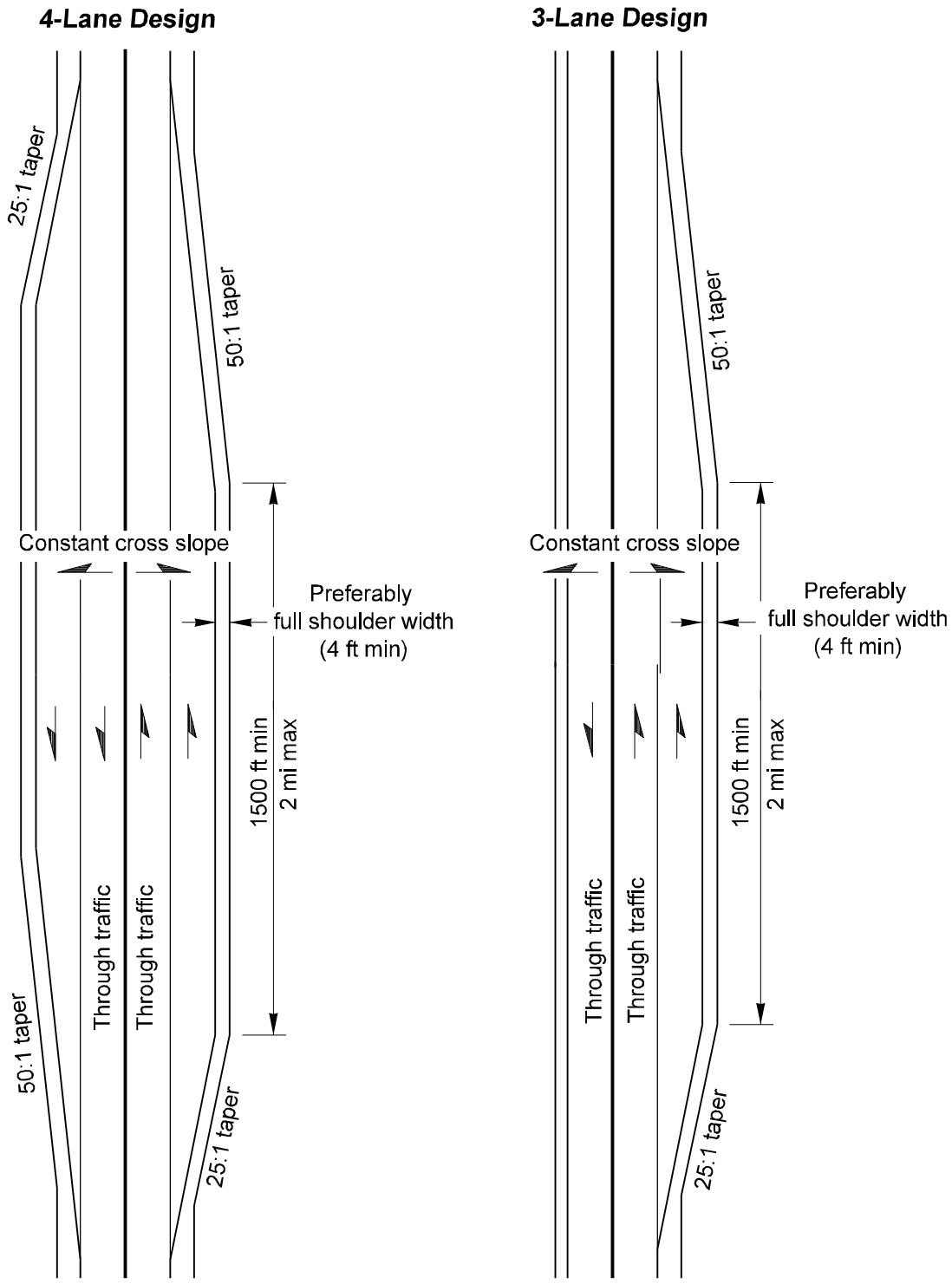


Auxiliary Climbing Lane
Figure 1010-4

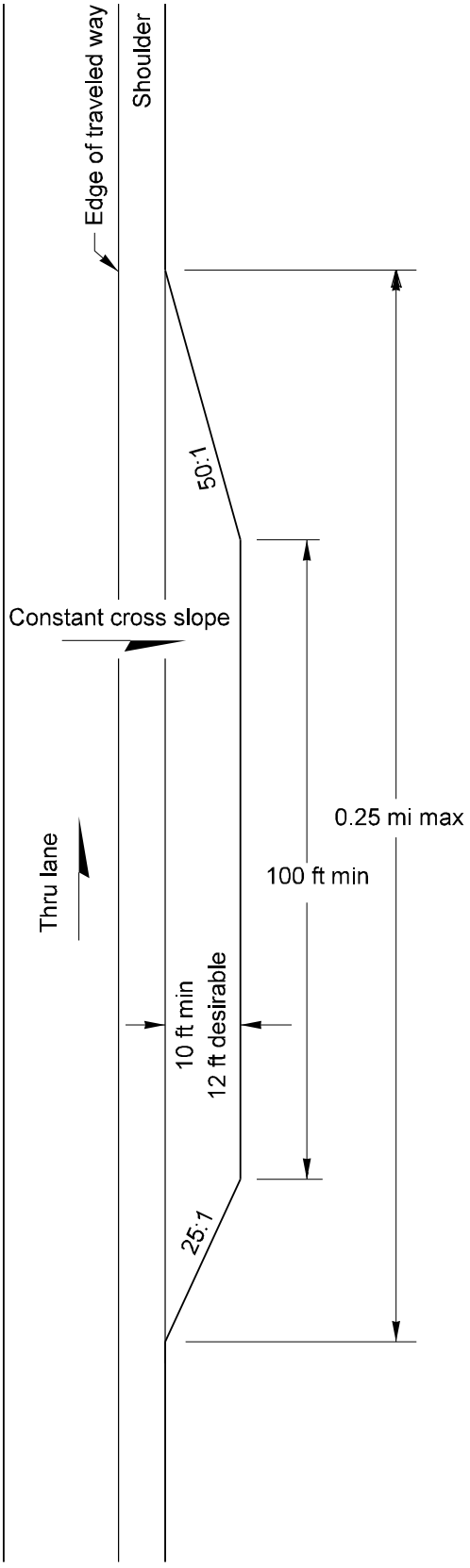


Warrant For Passing Lanes

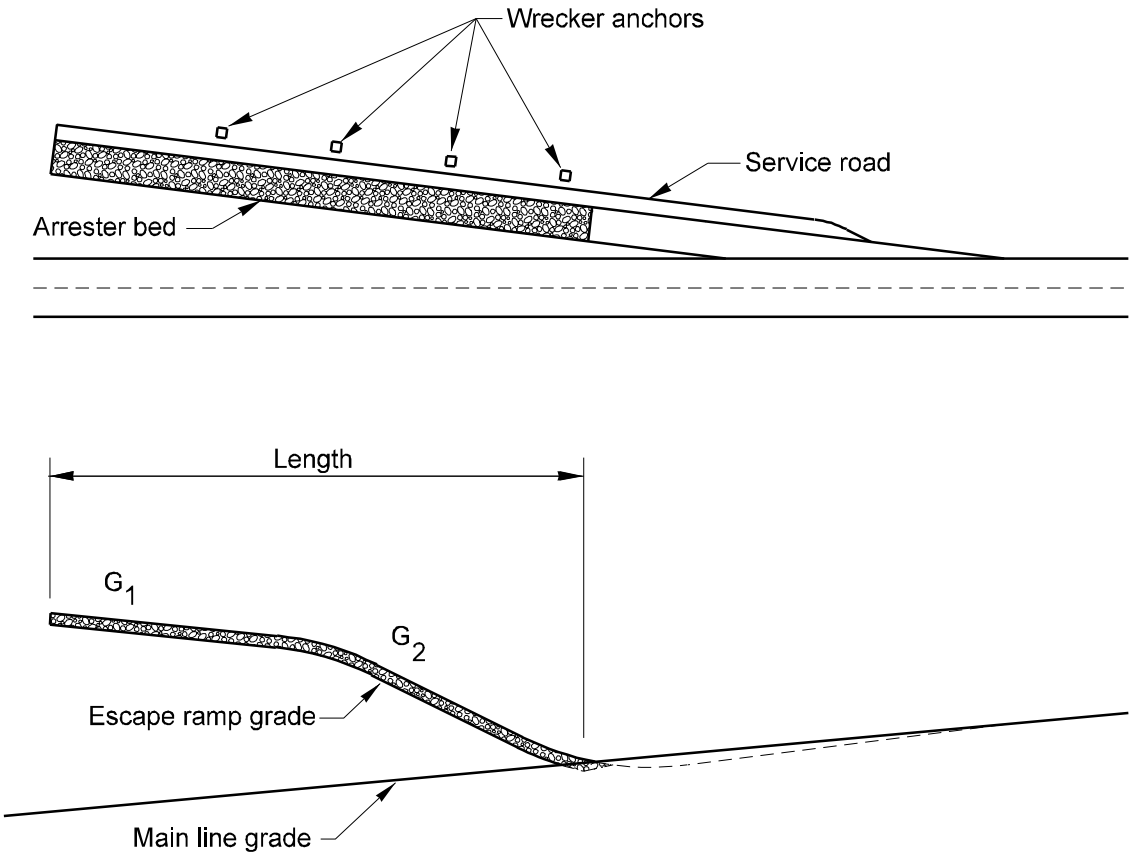
Figure 1010-5



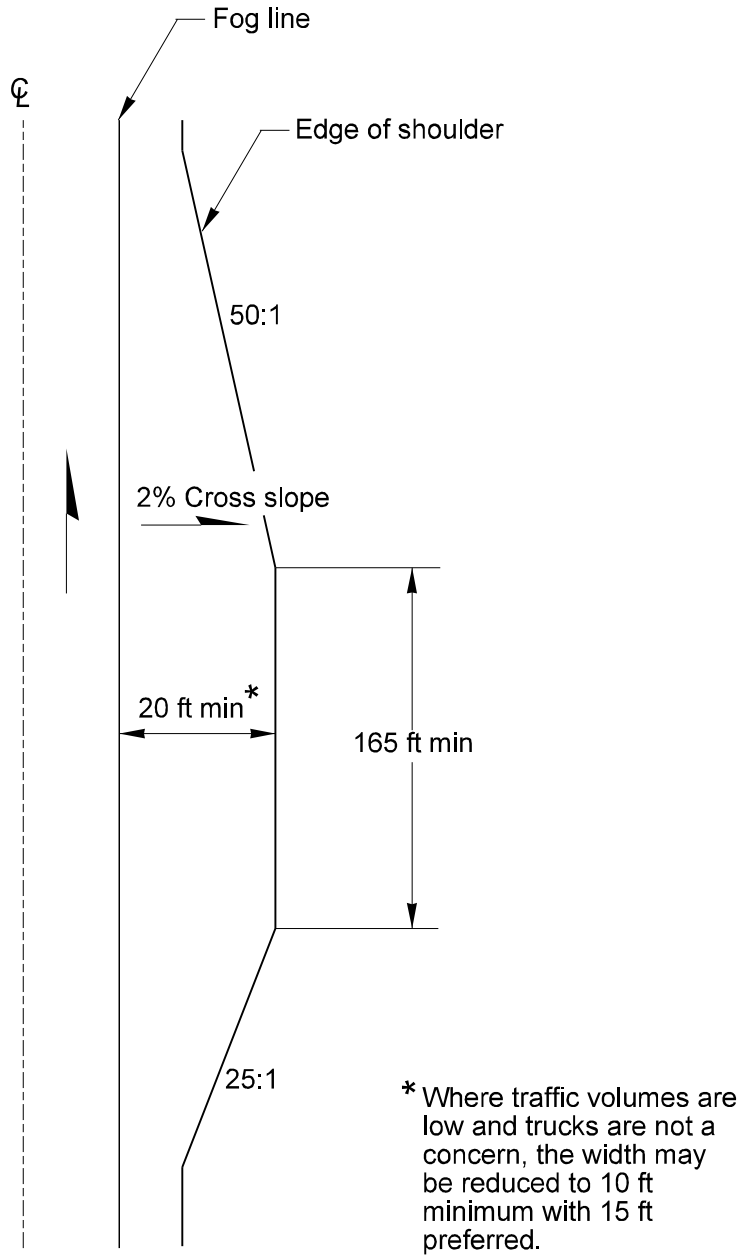
Auxiliary Passing Lane
Figure 1010-6



Slow Moving Vehicle Turnout
Figure 1010-7



Typical Emergency Escape Ramp
Figure 1010-8



Chain-Up/Chain-Off Area
Figure 1010-9